

Serial Link Troubleshooting

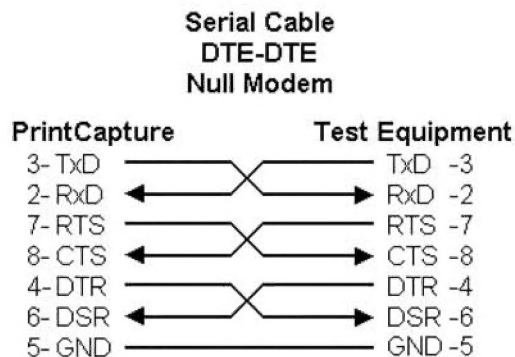
What type of cable do I need to connect my device?

The serial communications signals discussed below are:

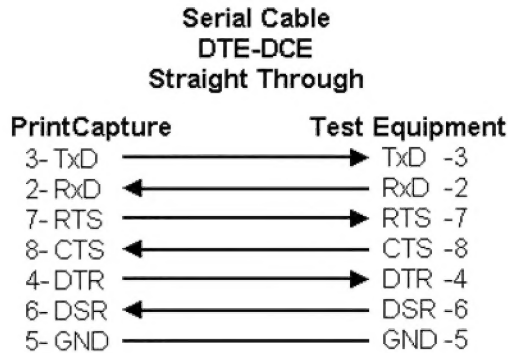
TxD - Transmitted Data
RxD - Received Data
RTS - Request To Send
CTS - Clear To Send
DTR - Data Terminal Ready
DSR - Data Set Ready

The serial port on a Windows-based computer is configured as DTE (Data Terminal Equipment). Some logic analyzers, spectrum analyzers, and oscilloscopes are also configured as DTE but some are configured as DCE (Data Communications Equipment). This configuration has more to do with the serial connector pin-outs than it does with operation. It is important to know the type of configuration on your test equipment in order to select the correct serial cable for the connection.

If your test equipment is configured as DTE you will need a cable to connect DTE to DTE, or what is referred to as a "null-modem" cable, as shown below for 9-pin serial connectors. Use a Belkin F3B207 or equivalent for this cable.



If your test equipment is configured as DCE you will need a cable to connect DTE to DCE, or what is referred to as a "straight-through" cable, as shown below for 9-pin serial connectors. Use a Belkin F2N209 or equivalent for this cable.



Hardware handshaking (flow control) is used to ensure error-free data communication between your computer and your oscilloscope, logic analyzer, or other device. Hardware handshaking uses voltage signals on the control lines of the serial cable to control whether sending or receiving is enabled. The computer and the test equipment must agree on the type of handshaking used for a communications session. The following table describes the control signals, the direction of flow control, and the signal's effect on the computer or the test equipment. For purposes of this discussion RTS/CTS handshaking is assumed. For DTR/DSR handshaking just switch the RTS/DTR and CTS/DSR labels.

RTS Input Flow Control	The RTS line is controlled by the computer . If the serial input buffer has enough room to receive data (at least half the buffer is empty), RTS is set high. If the input buffer has little room for incoming data (less than a quarter of the buffer is empty), RTS is set low.
CTS Output Flow Control	The CTS line is controlled by the test equipment. CTS is set high to indicate that the test equipment can receive data and set low to indicate that it cannot receive data.
DTR Status Information	The DTR line is controlled by the computer. It is set high to indicate that the computer. is up and running (ready). Some test equipment requires this signal to operate.
DSR Status Information	The DSR line is controlled by the test equipment. It is set high to indicate that the test equipment is up and running (ready). This signal is not required by the computer. but its status is displayed in one of the Status Bar indicators (CONN) to show whether the serial cable is connected.

I'm really having problems getting the serial data into my computer. What can I do to troubleshoot the serial interface?

Getting the serial link between your oscilloscope, logic analyzer, or other device and your computer up and running can be a snap or it can be frustrating as all get-out. Have patience! Sit back, take a deep breath, and let's get started.

You should first read this information to get an overview of the procedure before you start troubleshooting your serial link.

You need some basic information about your system in order to troubleshoot your serial link setup. And it doesn't matter if you are using a serial port straight from your test equipment or if you have to use a parallel-to-serial or GPIB-to-serial converter.

- You should review the **"What kind of serial cable do I need..."** FAQ, above, for background information on serial cables, signals, and hardware handshaking.
- Determine what serial port connectors exist on your computer. The connector on your computer will be either 25-pin or 9-pin and it will always be a male connector. And the serial port on your computer is always configured as DTE (Data Terminal Equipment).
- Determine what serial port connector is on your test equipment. The connector can be either male or female and it can be either 25-pin or 9-pin. There is no way to know by looking if the serial port is configured as DTE or DCE (Data Communications Equipment). You should refer to the test equipment documentation to see if you can determine if it is configured as DTE or DCE. If you don't know if your test equipment is configured as DTE or DCE don't worry about it. We'll still be able to tell using the tests below.

These are the items you are going to need to troubleshoot the serial link:

- Two small paper clips to use as jumpers later on. Straighten them out and then fold them in half so the legs are about 1/4 inch apart.
- An RS-232 Mini-Tester. This is a handy tool that uses bi-color (red/green) LEDs for monitoring the activity on the TxD (TD), RxD (RD), RTS, CTS, DSR, DTR, and CD signals. The RS232 tester looks like this



- You may need a 25-pin male to 9-pin female adapter if your computer has a 9-pin serial connector. This adapter will be used to connect the RS-232 Mini-Tester to your computer.

- You may need a 25-pin female to 9-pin male adapter if your test equipment has a 9-pin serial connector. This adapter will be used to connect the RS-232 Mini-Tester to your test equipment.
- You may need a 25-pin or 9-pin male gender changer (male connector on both ends) depending on whether your test equipment has a 25-pin or 9-pin connector. This adapter may be required to connect the RS-232 Mini-Tester to your test equipment.
- You may need a 25-pin or 9-pin female gender changer (female connector on both ends) depending on whether your test equipment has a 25-pin or 9-pin connector. This adapter may be required to connect the RS-232 Mini-Tester to your test equipment.
- A straight-through serial cable to connect the RS-232 Mini-Tester to your computer. A straight-through cable has a female connector on one end and a male connector on the other end. This may be either a 25-pin or 9-pin cable depending on what your computer requires.
- A straight-through serial cable to connect the RS-232 Mini-Tester to your oscilloscope, logic analyzer or spectrum analyzer. A straight-through cable has a female connector on one end and a male connector on the other end. This may be either a 25-pin or 9-pin cable depending on what your test equipment requires.
- A null-modem adapter to connect the RS-232 Mini-Tester to your oscilloscope, logic analyzer or spectrum analyzer. A null-modem adapter generally has both a male and a female connector. This may be either a 25-pin or 9-pin adapter depending on what your test equipment requires.
- A null-modem serial cable. A null-modem cable generally has a female connector on both ends of the cable. Depending on how the tests turn out below you may need this cable to connect your computer and your test equipment.

Now that you've gathered all the parts together it's time to start laying them out so you can see if you have everything you need.

It's always easier to follow if the example is a concrete setup, so this is how we connect our Tektronix 430A to the computer. Our computer has a 9-pin serial connector and the Tek 430A has a 9-pin male DTE serial connector. You will have to adjust the items a little to match your setup but it's basically the same. Don't make any connections yet - just lay them out on a table top so you can see if you have everything.

Remember, this is the layout for our Tek 430A.

- Start at the computer end of the serial link because it is the simplest to layout. Layout a straight-through 9-pin serial cable so the female end is toward the computer and the male end is toward the RS-232 Mini-Tester.
- Layout a 25-pin male to 9-pin female adapter so it can connect the above cable to the RS-232 Mini-Tester.
- Layout the RS-232 Mini-Tester so it can connect to the above adapter.
- Layout a 25-pin female to 9-pin male adapter so it can connect to the RS-232 Mini-Tester.
- Now jump to the test equipment end of the serial link. Layout a straight-through serial cable for the serial port of the test equipment so the cable will plug into the test equipment. (In our

case, the female end of the cable is toward the Tek 430A and the male end is toward the RS-232 Mini-Tester.)

- Now you have to match up the connectors between the serial cable for the test equipment and the RS-232 Mini-Tester. If they match up (male to female) then you are done. If they don't match up you will need one of the gender changers to create the match up. (For the Tek 430A we needed the female gender changer.)
- Verify that you can connect all the cables and adapters together between the computer and your test equipment. If you can then we can continue with the actual tests.

Now that you have the serial link all laid out on the table we can start our tests.

- Make sure your test equipment and any parallel-to-serial or GPIB-to-serial converters are turned off.
- Connect all the cables and adapters together that you laid out up above. You should have a continuous "cable" between the end that plugs into your computer and the end that plugs into your test equipment.
- Plug the cable into your test equipment but **don't** plug it into the computer yet!
- Turn on your test equipment and any parallel-to-serial or GPIB-to-serial converters.
- Take a look at the RS-232 Mini-Tester. If the RD LED is on (generally red) then you are set to run some more tests. If the TD LED is on then you have to use the null-modem adapter to swap the RS-232 signals.
- Once you have the RD LED on you should also see the CTS and/or DSR LEDs light up (generally green). This indicates that the required hardware handshaking signals are also present in the test equipment. Note that the TD LED will still be off because you aren't connected to your computer yet.
- Now use the paper clips to jumper two signals on the connector that would normally be connected to your computer's serial port. **Be careful! Don't force the paper clips into the sockets – they should easily slide in with just a tiny bit of resistance.** Jumper CTS to RTS (25-pin - jumper 4 & 5, 9-pin - jumper 7 & 8) and DSR to DTR (25-pin - jumper 6 & 20, 9-pin - jumper 4 & 6). You should now see RTS and DSR light up. This will fool the test equipment into thinking that the hardware handshaking lines are connected to your computer.

The 25-pin and 9-pin connectors are shown here so you can easily locate the sockets for the CTS, RTS, DSR, and DTR signals.



- At this point you should have the serial cable properly configured to complete the connection between your oscilloscope, logic analyzer, or spectrum analyzer and your computer. However, there is one more test you can run to make sure serial data is being transmitted by your test equipment.

When you press the 'print' button on your test equipment you should see the RD LED wink and blink. You won't actually see the LED wink and blink but the LED will look like it has both red and green at the same time.

If you have made it this far you have all the information you need to successfully connect your oscilloscope, logic analyzer, or spectrum analyzer to your computer. Now it's time to analyze the cable that you 'constructed' above and it's pretty easy to do at this point.

- Turn off your test equipment and any parallel-to-serial or GPIB-to-serial converters.
- If it will make you more comfortable you can also turn off your computer. We've never had any problems plugging in a serial cable when the computer is running – but you just never know.
- Did you have to use the null-modem adapter to get your cable working? If you did then you need to use a null-modem cable. If not you need to use a straight-through cable.
- Use the cable you selected just above (null-modem or straight-through) and lay it out on the table top.
- Now use whatever adapters (25-pin to 9-pin) and gender changers you need to mate the ends of the cable to your computer and your test equipment. **Don't use the null-modem adapter unless you are using it in place of a null-modem cable.** Don't plug the cable in yet; just make sure that both ends will mate with your computer and test equipment.
- Plug the cable into your computer first and then your test equipment.